



**WWF** *for a living planet*

**WWF Scotland**

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Friday 2<sup>nd</sup> October

Dear Ian Malcolm

Please find attached a response from WWF Scotland to the Scottish Government consultation document 'Low Carbon Vehicles'.

WWF Scotland regards climate change as the biggest threat facing humanity and campaigns at an international and national level for action to reduce our greenhouse gas emissions and prevent dangerous climate change. We very much welcome the opportunity to contribute to the Scottish Government's plan for tackling the emissions from our road transport sector through support for low carbon vehicles. We would also like to take the opportunity provided by this consultation to emphasise the importance of ensuring future policies for low carbon vehicles are pursued alongside a well resourced commitment to active travel, public transport provision and demand management.

WWF Scotland is currently undertaking a piece of policy research looking at the emissions savings from different levels of future electric vehicle use and the associated infrastructure needs. The results of this research will provide a valuable additional contribution to this policy discussion and WWF Scotland will provide the results as soon as they are available.

Yours faithfully

Dr Sam Gardner  
Climate Change Policy Officer



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At the same time as Scotland's total greenhouse gas (ghg) emissions have declined by 19%, emissions from across Scotland's road transport sector have increased by 11.5%<sup>1</sup>. It is clear that if Scotland is to be successful in meeting the 80% ghg emissions reduction target set out in the Climate Change (Scotland) Act the transport sector will have to reverse its current trend of growth in emissions and play a full part in meeting the target. Recent renewable energy targets at the EU, UK and Scottish level have further highlighted the importance of tackling the transport sectors energy demands<sup>2</sup>.

If we are to successfully reduce the emissions contribution from road transport there must be an integrated policy that delivers demand management measures and supports alternative low carbon travel options. This means commitment to public transport and active travel alongside the necessary investment in more efficient driving through behaviour change measures and the vital role of low carbon vehicles. Low carbon vehicles will have a critical role to play in this policy mix but as with any technology change they do not, on their own, provide a silver bullet to remove the emissions from road transport.

**WWF Scotland is currently undertaking a piece of research looking at the emissions reduction potential of electric vehicles in Scotland. This study will conclude after the consultation is closed but will provide valuable additional information that we hope the Scottish Government considers when developing its policy in this area.**

## Technology Options

### **1. Which low carbon technologies and fuels do you envisage will be first to be influential in reducing GHG emissions from the transport sector? Why?**

This question is answered on the basis of the current policy and private sector support mix that exists today

The European Commission targets for new car tail pipe emissions of 130g CO<sub>2</sub>/km by 2012 and 95g CO<sub>2</sub>/km by 2020 set the initial driver for the low carbon technologies that will have the early influence on ghg emissions. In the first instance stop-start technology will become the norm; both BMW and Bosch have predicted widespread availability of the technology by 2012. The additional costs to the vehicle are minimal at approximately £180 and £270 for petrol and diesel cars respectively and the technology provides a 5-8% reduction over the NEDC (New European Driving Cycle).

In the absence of an effective policy framework the introduction of alternatives to the internal combustion engine (ICE) will develop largely in order of the additional cost they attach to the vehicle, which in turn are heavily influenced by the price of battery technology. Hybrid electric vehicles, such as the Toyota Prius, will continue to lead the way. These will be followed by the Plug-in Hybrid vehicle with an onboard petrol generator which provides for a greater driving distance. The full electric vehicle will develop in parallel with these other 'introductory'

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<sup>1</sup> See

[Hhttp://www.airquality.co.uk/reports/cat07/0909231418\\_DA\\_GHGI\\_report\\_2007\\_maintext\\_Issue\\_1.pdf](http://www.airquality.co.uk/reports/cat07/0909231418_DA_GHGI_report_2007_maintext_Issue_1.pdf)

<sup>2</sup> See [Hhttp://www.scotland.gov.uk/Resource/Doc/917/0066300.pdf](http://www.scotland.gov.uk/Resource/Doc/917/0066300.pdf)

technology types but, in the absence of concerted policy effort, will take longer to make the necessary significant impact on transport emissions.

Low carbon vehicle research published by the EST<sup>3</sup> suggests that dedicated ethanol and biodiesel vehicles will not play a significant part in the future market. Instead biofuel supply will be used up to the level required by the RTFO to decarbonise conventional fuels with 5% or 10% blends. Biofuels will have a role to play as an transitional technology on the way to a full electric car fleet.

## 2. Which low carbon technologies and fuels do you believe will ultimately have the greatest emissions abatement impact? Why?

Full electric vehicles will have the greatest emissions abatement impact in the future as they have the potential to generate zero emissions from power plant to wheel when powered by 100% renewable electricity. The UK Committee on Climate Change (CCC) and BERR support this view with projections of future EV take up that see this technology taking off and dominating the market place beyond the late 2020s. The same analysis also identifies future greater use of fuel cell vehicles, although this is dependent on the necessary break through on fuel cell stack technology and hydrogen storage.

The internal combustion engine is inherently inefficient. In practice, only 18-23% of the chemical energy in the fuel actually reaches the wheels. Although efficiency improvements remain possible, e.g. by developing super-light vehicle bodies, improving aerodynamics, increasing the efficiency of auxiliary components, reducing tyre rolling resistance, etc. the potential efficiency gains in these areas apply in equal measure to electric vehicles, therefore they should complement – not forestall – the electrification of automotive transport. Electric vehicles are not only much more efficient in principle than conventional vehicles – converting some 65-75% of the energy stored in batteries into motion – they are also compatible with the full range of sustainable renewable energy sources including wind, solar, geothermal, hydro, wave, tidal, etc.

The table below describes the significantly improved efficiency and reduced emissions from battery electric vehicles in comparison to the current internal combustion engine.

**Table 1** Comparison of the CO<sub>2</sub> intensity of motive energy at the wheels of internal combustion engine vehicles (ICEV) and Battery Electric Vehicles (BEV) for representative US states and EU nations. Table taken from *Plugged In The End of the Oil Age*. Gary Kendall (2008) WWF

		CO <sub>2</sub> intensity of energy supply (gCO <sub>2</sub> /kWh)	(Refining & T&D efficiency (%))	Vehicle energy efficiency (%)	CO <sub>2</sub> intensity of motive energy (lower = better) (gCO <sub>2</sub> /kWh)
ICEV	Gasoline	242	83%	18%	1619
	Diesel	248	83%	23%	1300
US BEV	California	273	92%	65%	457
	Indiana	937	92%	65%	1567
	US Average	620	92%	65%	1037
EU BEV	Austria	221	92%	65%	370
	Greece	781	92%	65%	1306
	EU Average	370	92%	65%	619

<sup>3</sup> Revolution The road to a low carbon future. Energy Savings Trust.

Although the UK CCC also identify a future potentially important role for fuel cell vehicles it is important to keep in mind that hydrogen produced from sustainable renewable power and then recombined in fuel cells to create electricity suffers terrible efficiency losses; as an energy carrier, hydrogen cannot compete with its own energy source. On a life-cycle basis, electric vehicles convert renewable electricity into kilometres around three times more efficiently than hydrogen fuel cell vehicles. Until we have an excess of renewable generating capacity, there can be no justification for throwing away this much energy.

### **3. What timescales do you believe are feasible for the development of specific low carbon technologies and fuels? Are there any important intermediate milestones within these timescales?**

Timescales for development of either EVs or PHEVs will vary depending on what is regarded as the point of conclusion of their development. In both cases the technology already exists and has been developed to the point of application. However, it is also apparent that the technology will continue to develop partly in response to increasing demand, competition and the innovation this requires but also in response to the current R&D efforts being committed to ensuring EV and PHEV technology becomes mainstream. Electric vehicles are being launched this year to the market place and we can expect to see an acceleration of interest from both manufactures and the public. For instance Renault have said they expect sales of their electric vehicle models to reach 100 000 a year from 2012.

The major milestone in the development of technology to support the mass market penetration of electric vehicles relates to the emergence of a low cost lithium-based battery. There is widespread agreement that lithium-ion batteries will become the dominant technology for electric vehicles in the future (MIT 2007). In addition to the high energy and power density they provide compared to competing technologies they also exhibit other positive characteristics such as low self discharge rates, good life time and discharge cycle characteristics. However, despite being the dominant technology in consumer electronics the Li-ion battery is still in its infancy in terms of its application for vehicle propulsion and battery cost reduction remains the main challenge to future large scale deployment of EVs. The battery leasing business model is one proposed approach designed to reduce the initial capital cost and make the first electric vehicles directly competitive on the forecourt to ICEV.

### **4. What timescales do you believe are feasible for the uptake of specific low carbon technologies and fuels? Are there any important intermediate milestones within these timescales?**

This question will be addressed in more detail in the research WWF is taking forward on electric vehicles.

The literature provides some variation on expected uptake of specific low carbon vehicles and in particular to the future market penetration of EVs and much depends on the collective effect of global efforts to substitute the ICE with the electric vehicles. In recent years we have seen a rapidly accelerating international interest in EVs which is fuelling significant investment in both R&D and pilot projects. There are currently over 15 different EV pilot projects or public investment programmes across the EU trialling and demonstrating emerging EV technologies. For instance, in France 400 million euros is assigned to developing EVs and in Germany 500 million. Outside the EU the USA has committed \$2 billion in grants for the manufacture of advanced vehicles batteries and systems and 30% credit for advanced energy investments including plug in vehicle manufacturing. China plans to boost its annual production of electric or hybrid cars to 500 000 in the next two years from over 2000 in 2008.

It is clear that there is considerable attention being paid to the role of electric vehicles and this will do much to ensure that this new technology does not follow a traditional market penetration timeline for new vehicle technology of between 10-20 years to achieve 5% of new sales.

Work commissioned by BERR offers a number of scenarios describing future uptake of electric vehicles in 2020 and 2030. Figures for number of vehicles in the UK car fleet by 2030 range from 1,600,000 to 5,800,000 EVs and between 2,500,000 and 14,800,00 PHEVs. Work by EST describes how under their most effective policy scenario the take up of EVs will reach 261,000 by 2030 and that LCVs will outsell traditional fossil fuel cars. Please note that the figures between these studies are not directly comparable as one describes total EVs in the car pool by 2030 and the other the number of EV sales by 2030. Despite this difference of description both studies show that by 2030 EVs and PHEVs can make very significant market penetration.

**5. Are there other barriers to the development of such fuels and technologies that are not mentioned in this document? If so, what are they?**

No

**6. Are there other barriers to the uptake of such fuels and technologies that are not mentioned in this document? If so, what are they?**

One other potential additional barrier relating to EVs and PHEVs is the need to establish consumer confidence and interest in this new technology so as to strengthen the level of demand beyond that proportion of the population already motivated by issues of pollution and climate change.

**7. Are there any negative social impacts associated with either the development or uptake of such technologies/fuels? If so, what are they?**

There are potentially very significant social and environmental impacts associated with the development of biofuels that results in the displacement of food producing land, loss of biodiversity and net increase in greenhouse gas emissions as a result of the intensive landuse change.

The growth of electric vehicles also establishes an additional and in some cases new resource demand on the raw materials used in the battery technology. The estimated material composition of lithium-ion battery system for vehicle use is provided below.

<b>Material</b>	<b>Share</b>
Aluminium	30.3 %
Copper	13.9 %
Manganese	11.7 %
Plastics	9.7 %
Steel	9.2 %
Ethylene oxide	6.2 %
Carbon dioxide	6.2 %
Others	6.0 %
Carbon	5.7 %
Lithium, lithium salt	0.9 %
N-Methyl-2-pyrrolidone	0.2 %
Polyvinyliden fluoride	0.1 %

European lithium resources are considered to be negligible, with some small mineral deposits are to be found in Finland and Austria. The most significant reserves are in South-America and Asia. This immediately raises the prospect of resource extraction and the associated environmental impacts being divorced from the market demand in northern America and Europe. BERR predicts that China and Bolivia will become the leading producers of brine-based lithium carbonate for battery production by 2010. Every effort must be made to ensure

that anticipated growth in demand for these raw materials is matched by comprehensive international regulation that protects the environment and people who live at the place of extraction. There is also a need for the full quantification of the environmental impacts of battery production, recycling and disposal if we are to understand all the consequences of an increase in electric vehicle numbers.

The replacement of a traditional ICE vehicle with an electric equivalent does not automatically address many of the negative environmental and social consequences of a transport system dominated by the private car. Issues regarding health and mobility are common across both technologies and must be addressed. For instance, the negative impacts of congestion must be addressed regardless of fuel type. If the emergences of EVs are not to actually result in an increase in total vehicle km i.e. through their use for short journeys that were previously taken by bus or on foot, they need to be rolled out in conjunction with a truly integrated low carbon transport plan and in particular investment in active travel. For instance, although almost all car journeys occur within even the current range of EVs consumer purchases are made on the basis of total possible potential such as speed limits that are never reached, storage capacity that is rarely needed and a driving range that is required only once a year. To ensure the EV actually becomes established as the primary vehicle choice, rather than second car for limited use, there needs to be more development of placed on car clubs, car hire and quality intercity public transport network.

**9. Who would fund any grid upgrades? And, how might these costs be recovered?**

WWF does not have a view on this question other than to recommend that measures are put in place to ensure that any costs are not disproportionately placed on those with limited means and who make only a marginal contribution to road transport emissions.

**10. Do any of the technologies present any specific challenges or opportunities to island communities and sparsely populated rural areas in Scotland? If so, how might these challenges be addressed, and by whom?**

WWF does not foresee these low carbon technologies posing any specific challenges to island and sparsely populated rural areas of Scotland. Indeed the reverse is more likely with electric vehicles powered by community owned renewable electricity providing the chance for low cost mobility in areas that are often the first to be hit by rises in fossil fuel prices.

**Setting Targets**

**11. Do you think that having a twin approach for the public sector and other users is appropriate? If so, why? If not, why not?**

Yes it is appropriate to have a twin target approach. As the consultation makes clear public procurement of low carbon vehicles could have an important role in accelerating the wider support for new technologies such as electric vehicles. It is important that the public sector target is sufficiently ambitious as to make an impact on the wider market take up of new technologies. At the same time as transforming the public sector fleet there must be a wider public target for the take up of electric vehicles that drives policy design and implementation in the right direction.

**12. If so, should targets relate to the uptake of low carbon vehicles (either as a percentage of the fleet or an absolute number), or a reduction in total emissions across the fleets or another format of target? Why?**

The target should not refer to low carbon vehicle because just as the consultation states 'there is not currently a simple definition of what constitutes a LCV' and the term is therefore too ambiguous to give sufficient meaning to the target. Although it is clearly true that tail pipe

emissions do not reflect the 'full life cycle' emissions associated with EVs those emissions are reported at the point of power generation and will be tackled through the Scottish Government's clear commitment to decarbonise the power sector by 2030. If the public sector target is to be effective in increasing investment in the most appropriate technologies it has to explicitly identify those technologies as being the ones that count towards the target. If there is uncertainty regarding what counts, for instance in terms of being 'alternative powered' the purchasing power of the public sector will be diluted across the various interpretations fleet managers choose to take.

It is important to see this target in the context of the wider public sector duty set out in the Climate Change (Scotland) Act 2009 that requires public bodies to act "in the way best calculated to contribute to the delivery of the targets set in or under Part 1 of this Act". It should therefore not be necessary to frame this in terms of 'meet their emissions share' as this effectively repeats the CC Act and does nothing to direct investment towards the right technologies.

The Scottish Government must take a view as to which low carbon technology is best placed to deliver the required emissions reduction needed to hit the 2020 target of at least 42% and put us on the right path to an 80% reduction. WWF Scotland is of the view that electric vehicle technology provides the greatest emissions reduction potential, builds on our strong renewables capacity, is closest to mass market availability and would show the greatest return from public sector investment. **As such we would recommend that the target set for the public sector requires replacing the entire current fossil fuel car fleet and light vans with PHEVs and EVs by 2020.**

However, it is clear from the data presented in the consultation document that a significant percentage of emissions from the Local Authority fleet come from HGVs where electric propulsion will struggle to make a meaningful impact in the short term. Emissions reductions from this sector should be pursued through demand reduction measures, improvements in efficiencies delivered through smart driving, shared vehicle use to reduce number of journeys and greater proportion of HGVs fuelled by biofuels as electric car numbers increase. These changes should be done in order to comply with the duty in the CC Act and ensure savings are made from across the public sector transport fleet. Guidance could be provided on how best to deliver the emission savings from those vehicles where there is no electric option.

**13. If we follow a target relating to the public sector uptake of LCVs, what percentage of the fleet should be LCVs by 2020? Please give reasons for your answer.**

100% of the public sector car fleet should be either PHEV or EV by 2020. The average age of a public sector car is three years allowing for at least three replacement vehicles purchases between now and 2020. This is sufficient opportunity to plan and establish EVs in the car fleet and this is in line with projections of EV availability by 2020. In time the balance should shift to a predominantly EV fleet as the PHEV is effectively phased out as a transitional technology.

**14. If we follow a target relating to the uptake of LCVs across all road users, what percentage of all new vehicles should be LCVs by 2020? Please give reasons for your answer.**

This question is the subject of a current research programme for WWF Scotland. The research will allow us to provide an evidence based recommendation as to what an appropriate target should be. The future projections of electric vehicle ownership provided by the UK CCC and analysis for BERR offer a starting point for identifying a total Scotland fleet target for LCVs. The CCC describes a target where EVs make up 12.1% of new cars purchased in 2020 and

some 16% of new vans with other significant EV technology types such as the PHEV spread across cars, vans and HGVs.

**16. As LCVs may have higher upfront costs than traditional vehicles (albeit with a smaller discrepancy between lifecycle costs) do you consider it to be efficient use of public resources to devote a greater short-term budget towards the purchase of LCVs? If so, why? If not, why not?**

Yes it is an efficient use of public resources to invest in vehicles that not only have significantly lower running costs, and ultimately cheaper total lifecycle costs, but also make an important contribution to tackling climate change and therefore reducing our exposure to the huge costs associated with the impacts of dangerous climate change. Some of the steps to tackling climate change do present an immediate short term cost. However, this represents an investment in new low carbon technologies that Scotland can help pioneer while mitigating the future cost impacts of climate change.

The required change to the public sector fleet should also prompt a review of its size and need. An initial higher cost will help the public sector identify other means of delivering its public service without being so reliant on the personal vehicle.

A concerted shift to zero emission vehicles will also provide important benefits in terms of improved air quality in urban environments and reduced cost associated with the health impacts resulting from poor air quality.

**17. Are there any opportunities or barriers to public sector procurement of LCVs that are not mentioned in this document? If so, what are they?**

One significant opportunity that exists for the Glasgow area and could have a much wider ripple effect across Scotland is the Commonwealth Games in 2014. Glasgow will attract an international audience and must present itself as the low carbon games. The high profile presence of electric vehicles in and around the city could help position Scotland at the forefront of this new industry and act as a catalyst for other cities across Scotland.

**18. What are the individual roles of different groups and organisations in ensuring the provision of any infrastructure required for low carbon vehicles?**

The Scottish Government has a clear role to provide leadership on this issue and set the right policy framework to drive investment in low carbon vehicles and in particular electric vehicles. Power companies have a potentially important role to play in providing the supporting infrastructure and generating renewable electricity to meet the demand. There is also a clear need to ensure the roll out of Smart Meters happens in parallel with the growth in EV as they will have a critical role to play in managing the additional demand on the grid.

**19. Are there other supply side/capacity constraints impacting on LCV development and uptake? If so, what are they?**

WWF is not aware of any supply side capacity constraints.

**20. Are there barriers to the development of an indigenous low carbon vehicle industry in Scotland? If so, what are they and how might they be overcome?**

Although Scotland does not currently have an indigenous car manufacturing industry it does have considerable expertise in aspects of vehicle manufacturing and in particular in electronic engineering and as such there are no obvious barriers to Scotland playing an important role in a future low carbon vehicle industry.

**21. Should Scotland's industry focus on particular vehicle types? If so, what are they and why? If not, why not?**

Scotland should continue to build expertise where it already has an established role, such as provided by Allied Vehicles and companies such as Axion. However, longer term we should have a strategy to ensure we have an established focus across the breadth of EV supply chain, including a diversity of vehicle types.

**22. Are there gaps in the supply chain? If so, what are they and how might these be overcome?**

WWF is not aware of any gaps in the supply chain.

**23. Do we have the required skills base for the development of this market? If not, where are the gaps?**

WWF does not have the expertise to answer this question but highlights the excellent R&D potential in our Universities and our existing expertise in electronics and renewables; given the right policy stimulus there ought to be no reason we cannot have a world leading skill base in this area.

**24. How could the various stakeholders collaborate to stimulate the development and uptake of LCVs?**

WWF Scotland is keen to play a part in the future role of electric vehicles in Scotland and will work with other stakeholders to promote their benefits and role in contributing to a low carbon Scotland.